

PATENT COOPERATION TREATY

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Commissioner
 US Department of Commerce
 United States Patent and Trademark
 Office, PCT
 2011 South Clark Place Room
 CP2/5C24
 Arlington, VA 22202
 ETATS-UNIS D'AMERIQUE
 in its capacity as elected Office

Date of mailing (day/month/year) 14 May 2001 (14.05.01)	
International application No. PCT/GB00/03545	Applicant's or agent's file reference IPD/P2855/WOD
International filing date (day/month/year) 15 September 2000 (15.09.00)	Priority date (day/month/year) 21 September 1999 (21.09.99)
Applicant GOODBY, John, William et al	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:
 08 March 2001 (08.03.01)

☐ in a notice effecting later election filed with the International Bureau on:

2. The election ☒ was
☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.: (41-22) 740.14.35	Authorized officer Zakaria EL KHODARY Telephone No.: (41-22) 338.83.38
---	--

PATENT COOPERATION TREATY

PCT

From the INTERNATIONAL BUREAU

NOTIFICATION OF THE RECORDING
OF A CHANGE(PCT Rule 92bis.1 and
Administrative Instructions, Section 422)

To:

BOWDERY, A., O.
Qinetiq Limited
IP Formalities
A4 Bldg., Cody Technology Park
Ively Road, Farnborough
Hampshire GU14 0LX
ROYAUME-UNIDate of mailing (day/month/year)
25 October 2001 (25.10.01)Applicant's or agent's file reference
IPD/P2855/WOD

IMPORTANT NOTIFICATION

International application No.
PCT/GB00/03545International filing date (day/month/year)
15 September 2000 (15.09.00)

1. The following indications appeared on record concerning:

☒ the applicant ☐ the inventor ☐ the agent ☐ the common representative

Name and Address

THE SECRETARY OF STATE FOR DEFENCE
Defence Evaluation Research Agency
A4 Building
Ively Road
Farnborough
Hampshire GU14 0LX
United Kingdom

State of Nationality

GB

State of Residence

GB

Telephone No.

Facsimile No.

Teleprinter No.

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

☒ the person ☐ the name ☐ the address ☐ the nationality ☐ the residence

Name and Address

QINETIQ LIMITED
85 Buckingham Gate
London SW1 6TD
United Kingdom

State of Nationality

GB

State of Residence

GB

Telephone No.

Facsimile No.

Teleprinter No.

3. Further observations, if necessary:

The agent's address has been changed accordingly.

4. A copy of this notification has been sent to:

☒ the receiving Office ☐ the designated Offices concerned
☐ the International Searching Authority ☒ the elected Offices concerned
☒ the International Preliminary Examining Authority ☐ other:The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Authorized officer

Dominique DELMAS

Facsimile No.: (41-22) 740.14.35

Telephone No.: (41-22) 338.83.38

RECEIVED 21 DEC 2001

WIPO

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference IPD/P2855/WOD	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/GB00/03545	International filing date (day/month/year) 15/09/2000	Priority date (day/month/year) 21/09/1999
International Patent Classification (IPC) or national classification and IPC C07D307/78		
Applicant QINETIQ LIMITED et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.



2. This REPORT consists of a total of 5 sheets, including this cover sheet.

- ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 15 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☒ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☒ Certain observations on the international application

Date of submission of the demand 08/03/2001	Date of completion of this report 19.12.2001
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Baston, E Telephone No. +49 89 2399 8229 

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB00/03545

I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

Description, pages:

1-127 as originally filed

Claims, No.:

1-29 as received on 15/08/2001 with letter of 15/08/2001

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/GB00/03545

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-29
	No:	Claims	
Inventive step (IS)	Yes:	Claims	26,29
	No:	Claims	1-25,27,28
Industrial applicability (IA)	Yes:	Claims	1-29
	No:	Claims	

2. Citations and explanations
see separate sheet

VI. Certain documents cited

1. Certain published documents (Rule 70.10)

and / or

2. Non-written disclosures (Rule 70.9)

see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
see separate sheet

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB00/03545

To section V

The following documents were cited in the search report and were considered for the examination of the present application:

- D1: DATABASE WPI Section Ch, Week 199537 Derwent Publications Ltd., London, GB; Class E19, AN 1995-281175 -& JP 07 179856 A (CANON KK), 18 July 1995
- D2: EP-A-0 666 262 (CANON KK) 9 August 1995
- D3: EP-A-0 678 509 (CANON KK) 25 October 1995
- D6: DE 199 00 517 A (MERCK PATENT GMBH) 22 July 1999 (1999-07-22) cited in the application
- D7: DE 196 30 068 A (BASF AG) 29 January 1998 (1998-01-29) cited in the application
- D8: SHTAREV, ALEXANDER B. ET AL: 'Synthesis of Conjugated F-Polyenes Containing Thienyl Ring Systems' J. ORG. CHEM. (1997), 62(16), 5608-5614

The present application is related to compounds (e.g. substituted benzofurans, which might contain a biphenyl moiety), that are considered to be useful as liquid crystals for purposes like display devices.

The subject-matter of claims 1-29 is considered to meet formally the requirements of Art. 33(2) PCT; those compounds from relevant documents of the prior art (D1-D3) are excluded via proviso.

Claims 1-25 and 27 do not involve an inventive step (Art. 33(3) PCT), since D1 (abstract), D2 (page 70, claim 1) and D3 (page 29, claim 1) already propose compounds of the present application.

Moreover it has to be stated, that unlimited expressions like "optionally substituted heterocyclyl" are not suitable to define, for which subject-matter protection might be sought (compare section VIII).

Claim 26 is novel and inventive, since this process which involves a Suzuki-cross-coupling reaction is neither anticipated nor suggested by any document of the prior art. Claim 29 relates to specific examples from this application, which are neither anticipated nor suggested by any document of the prior art.

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/GB00/03545

To section VI

D4: DE 199 09 760 A (MERCK PATENT GMBH) 21 October 1999

D5: DE 199 09 761 A (MERCK PATENT GMBH) 21 October 1999

The priority document of the present application is not yet available. In case that the presently claimed subject-matter is not fully supported by the priority document, D4 and D5 might be relevant for the assessment of novelty and / or inventive step in the national / European phase.

To section VIII

Document D7 (DE 196 30 068 A) should be identified in the description (Rule 5.1(a)(iii) PCT).

Some claims are not acceptable due to unlimited expressions like "optionally substituted heterocyclyl", "optionally substituted hydrocarbyl", "lower alkyl", "aromatic, heteroaliphatic, heteroaromatic ring-systems", "polymerisable group".

Although only benzofuran-thiophen-derivatives are claimed, the description (page 2, line 10) mentions that this application would relate to benzopyrans as well (Art. 5, 6 PCT).

PATENT COOPERATION TREATY

IPD

From the INTERNATIONAL SEARCHING AUTHORITY

PCT

NOTIFICATION OF TRANSMITTAL OF
THE INTERNATIONAL SEARCH REPORT
OR THE DECLARATION

FARNBOROUGH (PCT Rule 44.1)

To:

BOWDERY, A. O.
D/IPD, DERA Formalities
A4 Building, Ively Road
Farnborough
Hampshire GU14 0LX
UNITED KINGDOM

Date of mailing
(day/month/year)

30/11/2000

Applicant's or agent's file reference

IPD/P2855/WOD

FOR FURTHER ACTION

See paragraphs 1 and 4 below

International application No.

PCT/GB 00/ 03545

International filing date
(day/month/year)

15/09/2000

Applicant

THE SECRETARY OF STATE FOR DEFENCE...

1. ☒ The applicant is hereby notified that the International Search Report has been established and is transmitted herewith.

Filing of amendments and statement under Article 19:

The applicant is entitled, if he so wishes, to amend the claims of the International Application (see Rule 46):

When? The time limit for filing such amendments is normally 2 months from the date of transmittal of the International Search Report; however, for more details, see the notes on the accompanying sheet.

Where? Directly to the International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland
Facsimile No.: (41-22) 740.14.35

For more detailed instructions, see the notes on the accompanying sheet.

2. ☐ The applicant is hereby notified that no International Search Report will be established and that the declaration under Article 17(2)(a) to that effect is transmitted herewith.

3. ☐ **With regard to the protest** against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

☐ the protest together with the decision thereon has been transmitted to the International Bureau together with the applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.

☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Further action(s):** The applicant is reminded of the following:

Shortly after **18 months** from the priority date, the international application will be published by the International Bureau.
If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau as provided in Rules 90bis.1 and 90bis.3, respectively, before the completion of the technical preparations for international publication.

Within **19 months** from the priority date, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase until 30 months from the priority date (in some Offices even later).

Within **20 months** from the priority date, the applicant must perform the prescribed acts for entry into the national phase before all designated Offices which have not been elected in the demand or in a later election within 19 months from the priority date or could not be elected because they are not bound by Chapter II.

Name and mailing address of the International Searching Authority



European Patent Office, P.B. 5818 Patentlaan 2
NL-2280 HV Rijswijk
Tel. (+31-70) 340-2040. Tx. 31 651 epo nl.
Fax: (+31-70) 340-3016

Authorized officer

Alex Schmidt

These Notes are intended to give the basic instructions concerning the filing of amendments under article 19. The Notes are based on the requirements of the Patent Cooperation Treaty, the Regulations and the Administrative Instructions under that Treaty. In case of discrepancy between these Notes and those requirements, the latter are applicable. For more detailed information, see also the PCT Applicant's Guide, a publication of WIPO.

In these Notes, "Article", "Rule", and "Section" refer to the provisions of the PCT, the PCT Regulations and the PCT Administrative Instructions respectively.

INSTRUCTIONS CONCERNING AMENDMENTS UNDER ARTICLE 19

The applicant has, after having received the international search report, one opportunity to amend the claims of the international application. It should however be emphasized that, since all parts of the international application (claims, description and drawings) may be amended during the international preliminary examination procedure, there is usually no need to file amendments of the claims under Article 19 except where, e.g. the applicant wants the latter to be published for the purposes of provisional protection or has another reason for amending the claims before international publication. Furthermore, it should be emphasized that provisional protection is available in some States only.

What parts of the international application may be amended?

Under Article 19, only the claims may be amended.

During the international phase, the claims may also be amended (or further amended) under Article 34 before the International Preliminary Examining Authority. The description and drawings may only be amended under Article 34 before the International Examining Authority.

Upon entry into the national phase, all parts of the international application may be amended under Article 28 or, where applicable, Article 41.

When?

Within 2 months from the date of transmittal of the international search report or 16 months from the priority date, whichever time limit expires later. It should be noted, however, that the amendments will be considered as having been received on time if they are received by the International Bureau after the expiration of the applicable time limit but before the completion of the technical preparations for international publication (Rule 46.1).

Where not to file the amendments?

The amendments may only be filed with the International Bureau and not with the receiving Office or the International Searching Authority (Rule 46.2).

Where a demand for international preliminary examination has been/is filed, see below.

How?

Either by cancelling one or more entire claims, by adding one or more new claims or by amending the text of one or more of the claims as filed.

A replacement sheet must be submitted for each sheet of the claims which, on account of an amendment or amendments, differs from the sheet originally filed.

All the claims appearing on a replacement sheet must be numbered in Arabic numerals. Where a claim is cancelled, no renumbering of the other claims is required. In all cases where claims are renumbered, they must be renumbered consecutively (Administrative Instructions, Section 205(b)).

The amendments must be made in the language in which the international application is to be published.

What documents must/may accompany the amendments?

Letter (Section 205(b)):

The amendments must be submitted with a letter.

The letter will not be published with the international application and the amended claims. It should not be confused with the "Statement under Article 19(1)" (see below, under "Statement under Article 19(1)").

The letter must be in English or French, at the choice of the applicant. However, if the language of the international application is English, the letter must be in English; if the language of the international application is French, the letter must be in French.

NO TO FORM PCT/ISA/220 (continued)

The letter must indicate the differences between the claims as filed and the claims as amended. It must, in particular, indicate, in connection with each claim appearing in the international application (it being understood that identical indications concerning several claims may be grouped), whether

- (i) the claim is unchanged;
- (ii) the claim is cancelled;
- (iii) the claim is new;
- (iv) the claim replaces one or more claims as filed;
- (v) the claim is the result of the division of a claim as filed.

The following examples illustrate the manner in which amendments must be explained in the accompanying letter:

1. [Where originally there were 48 claims and after amendment of some claims there are 51]:
"Claims 1 to 29, 31, 32, 34, 35, 37 to 48 replaced by amended claims bearing the same numbers; claims 30, 33 and 36 unchanged; new claims 49 to 51 added."
2. [Where originally there were 15 claims and after amendment of all claims there are 11]:
"Claims 1 to 15 replaced by amended claims 1 to 11."
3. [Where originally there were 14 claims and the amendments consist in cancelling some claims and in adding new claims]:
"Claims 1 to 6 and 14 unchanged; claims 7 to 13 cancelled; new claims 15, 16 and 17 added." or
"Claims 7 to 13 cancelled; new claims 15, 16 and 17 added; all other claims unchanged."
4. [Where various kinds of amendments are made]:
"Claims 1-10 unchanged; claims 11 to 13, 18 and 19 cancelled; claims 14, 15 and 16 replaced by amended claim 14; claim 17 subdivided into amended claims 15, 16 and 17; new claims 20 and 21 added."

"Statement under article 19(1)" (Rule 46.4)

The amendments may be accompanied by a statement explaining the amendments and indicating any impact that such amendments might have on the description and the drawings (which cannot be amended under Article 19(1)).

The statement will be published with the international application and the amended claims.

It must be in the language in which the international application is to be published.

It must be brief, not exceeding 500 words if in English or if translated into English.

It should not be confused with and does not replace the letter indicating the differences between the claims as filed and as amended. It must be filed on a separate sheet and must be identified as such by a heading, preferably by using the words "Statement under Article 19(1)."

It may not contain any disparaging comments on the international search report or the relevance of citations contained in that report. Reference to citations, relevant to a given claim, contained in the international search report may be made only in connection with an amendment of that claim.

Consequence if a demand for international preliminary examination has already been filed

If, at the time of filing any amendments under Article 19, a demand for international preliminary examination has already been submitted, the applicant must preferably, at the same time of filing the amendments with the International Bureau, also file a copy of such amendments with the International Preliminary Examining Authority (see Rule 62.2(a), first sentence).

Consequence with regard to translation of the international application for entry into the national phase

The applicant's attention is drawn to the fact that, where upon entry into the national phase, a translation of the claims as amended under Article 19 may have to be furnished to the designated/elected Offices, instead of, or in addition to, the translation of the claims as filed.

For further details on the requirements of each designated/elected Office, see Volume II of the PCT Applicant's Guide.

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference IPD/P2855/WOD	FOR FURTHER ACTION see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. PCT/GB 00/ 03545	International filing date (day/month/year) 15/09/2000	(Earliest) Priority Date (day/month/year) 21/09/1999
Applicant THE SECRETARY OF STATE FOR DEFENCE...		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

- a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

- b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☐ **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,

☐ the text is approved as submitted by the applicant.

☒ the text has been established by this Authority to read as follows:

LIQUID CRYSTAL COMPOUNDS

5. With regard to the **abstract**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.

☐ as suggested by the applicant.

☐ because the applicant failed to suggest a figure .

☐ because this figure better characterizes the invention.

☐ None of the figures.

INTERNATIONAL SEARCH REPORT

International Application No

PC 00/03545

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 C07D307/78 C07D333/52 C09K19/34

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 C07D C09K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

CHEM ABS Data, WPI Data, EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DATABASE WPI Section Ch, Week 199537 Derwent Publications Ltd., London, GB; Class E19, AN 1995-281175 XP002153297 -& JP 07 179856 A (CANON KK), 18 July 1995 (1995-07-18) abstract ---	1,2,5,6, 13,15
X	EP 0 666 262 A (CANON KK) 9 August 1995 (1995-08-09) examples 39,51 ---	1,13,15
X	EP 0 678 509 A (CANON KK) 25 October 1995 (1995-10-25) page 12, line 10 example 3 --- -/--	1,2,13, 15



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

* Special categories of cited documents:

A document defining the general state of the art which is not considered to be of particular relevance

E earlier document but published on or after the international filing date

L document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

O document referring to an oral disclosure, use, exhibition or other means

P document published prior to the international filing date but later than the priority date claimed

T later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

X document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

Y document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

G document member of the same patent family

Date of the actual completion of the international search

20 November 2000

Date of mailing of the international search report

30/11/2000

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Puetz, C

INTERNATIONAL SEARCH REPORT

International Application No

PC 00/03545

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,X	DE 199 09 760 A (MERCK PATENT GMBH) 21 October 1999 (1999-10-21) the whole document ---	1,2,5-9, 13,15
P,X	DE 199 09 761 A (MERCK PATENT GMBH) 21 October 1999 (1999-10-21) page 29 claims 1,10-13 ---	1,2,13, 15
A	DE 199 00 517 A (MERCK PATENT GMBH) 22 July 1999 (1999-07-22) cited in the application the whole document ---	1,13,15
A	DE 196 30 068 A (BASF AG) 29 January 1998 (1998-01-29) cited in the application the whole document ---	1,13,15
A	SHTAREV, ALEXANDER B. ET AL: "Synthesis of Conjugated F-Polyenes Containing Thienyl Ring Systems" J. ORG. CHEM. (1997), 62(16), 5608-5614 , XP002153296 page 5612, compound no. (11a) page 5613, compound no. (11b) -----	1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PC 00/03545

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 7179856 A	18-07-1995	NONE	
EP 0666262 A	09-08-1995	JP 3062988 B JP 8027139 A DE 69518554 D US 5849217 A	12-07-2000 30-01-1996 05-10-2000 15-12-1998
EP 0678509 A	25-10-1995	JP 7309838 A US 5695684 A	28-11-1995 09-12-1997
DE 19909760 A	21-10-1999	NONE	
DE 19909761 A	21-10-1999	NONE	
DE 19900517 A	22-07-1999	NONE	
DE 19630068 A	29-01-1998	AU 4115797 A WO 9804544 A	20-02-1998 05-02-1998

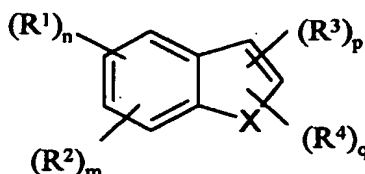
REPLACED BY
ART 34 AMDT

128

Claims

1. A liquid crystal compound of general formula (I)

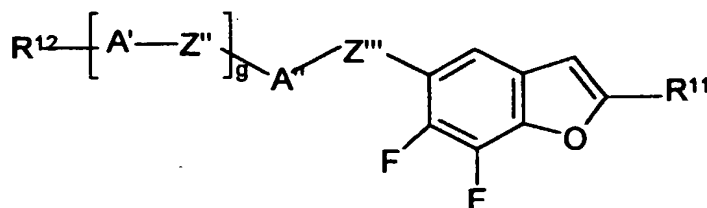
5



(I)

where X is O, S or Se,

- 10 each R^1 and R^3 are independently selected from cyano, halo, optionally substituted hydrocarbyl, optionally substituted alkoxy, optionally substituted heterocyclyl, a group $R^{13}C(O)O-$ where R^{13} is optionally substituted hydrocarbyl or carboxy or a hydrocarbyl ester or amide thereof, provided that at least one of group R^1 or R^3 is other than cyano or halo,
- 15 each R^2 and R^4 is independently selected from halo, nitro, lower alkyl optionally substituted by halo, or a group $R^{14}C(O)O-$ where R^{14} is optionally substituted hydrocarbyl,
- n is 1 or 2, m is 0, 1, 2 or 3, p is 1 or 2 and q is 0 or 1, provided $n + m$ does not exceed 4 and $p + q$ does not exceed 2, and further provided the compounds are other than a
- 20 compound of formula (A) or (B)



(A)

where R^{11} is a C_{1-8} alkyl group;

- 25 R^{12} is H , or a C_{1-12} alkyl or C_{2-12} alkenyl group, either of which may be optionally substituted by one CN or CF_3 group or one or more halogen atoms; and wherein one or

more $-\text{CH}_2$ -groups in the alkyl or alkenyl groups is optionally replaced by $-\text{O}-$, $-\text{S}-$, $-\text{C}(\text{O})-$, $\text{C}(\text{O})\text{O}-$, $-\text{OC}(\text{O})-$ or $-\text{OC}(\text{O})\text{O}-$ provided that oxygen and sulphur atoms are not directly linked to each other;

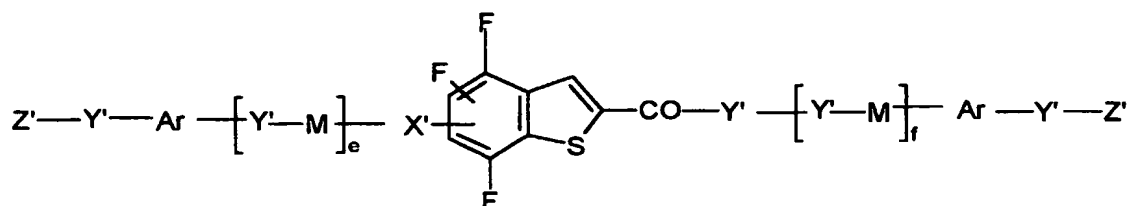
A' and A'' are independently selected from:

- 5 a) a trans-1,4-cyclohexylene residue in which one or more non-adjacent CH_2 groups can be replaced by $-\text{O}-$ and/or $-\text{S}-$;
- b) a 1,4-cyclohexenyl residue;
- c) a 1,4-phenylene residue in which one or two CH groups can be replaced by N ;
- d) a residue from the group 1,4-bicyclo(2,2,2)-octylene, piperidine-1,4-diyl,
- 10 naphthalene-2,6-diyl, decahydronaphthalene-2,6-diyl and 1,2,3,4-tetrahydronaphthalene-2,6-diyl;

whereby residues a), b) and c) can be substituted by CN , Cl , or F ,

Z'' and Z''' independently represent $-\text{C}(\text{O})\text{O}-$, $-\text{OC}(\text{O})-$, $-\text{CH}_2\text{O}-$, $-\text{OCH}_2-$, $-\text{CH}_2\text{CH}_2-$, $-\text{CH}=\text{CH}-$, $-\text{C}\equiv\text{C}-$ or a single bond and

- 15 g is 0,1 or 2



(B)

20

where

each Ar is a bond or a spacer group such as a C_{2-30} alkylene or C_{2-30} alkenylene group, optionally substituted with C_{1-4} alkyl, fluoro, chloro, bromo, cyano, or hydroxy, and optionally interposed with one or more $-\text{O}-$, $-\text{S}-$, $-\text{NH}-$, $-\text{NR}^c-$, $-\text{COO}-$, OCO , OCOO or

25

CO ;

each M is independently selected from optionally substituted aliphatic, aromatic, heteroaliphatic or a heteroaromatic ring system,

X' is O , S , COO , OCOO , CONH or CONR^c where R^c is C_{1-4} alkyl;

e and f are independently selected from 0,1 or 2,

each Y' group is independently selected from O, S, COO, OCO, OCOO, CONH, NHCO, $CONR^c$, or NR^cCO where R^c is as defined above;

each Z' group is independently selected from hydrogen, cyano or a polymerisable group.

5

2. A compound according to claim 1 wherein n is 1, and m is 0 or 1.

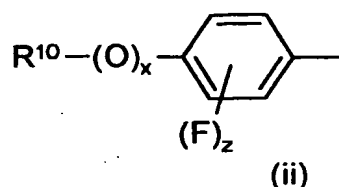
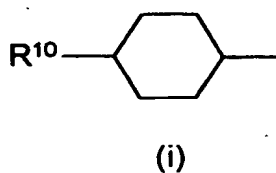
3. A compound according to claim 1 or claim 2 wherein no more than one of the groups R^1 and R^2 is fluoro.

10

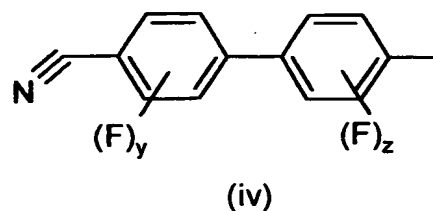
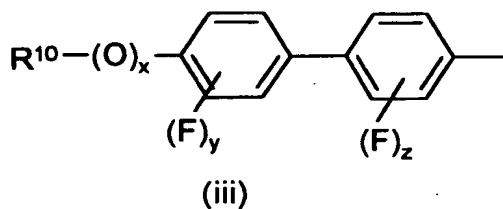
4. A compound according to any one of the preceding claims where one of R^1 or R^3 is cyano or halo and the other is optionally substituted alkyl, optionally substituted cycloalkyl, optionally substituted alkenyl, optionally substituted alkynyl, an optionally substituted aryl, optionally substituted heterocyclyl, carboxy or an ester thereof.

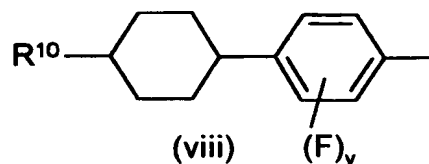
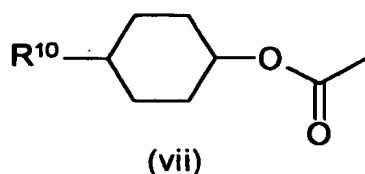
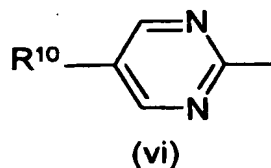
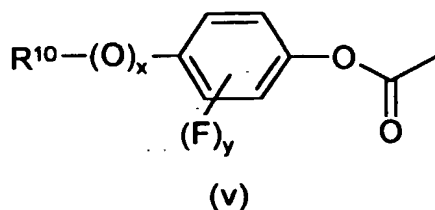
15

5. A compound according to any one of the preceding claims wherein R^1 or R^3 where these are other than cyano or halo are selected from groups of formula (i), (ii), (iii), (iv), (v), (vi), (vii) or (viii)



20



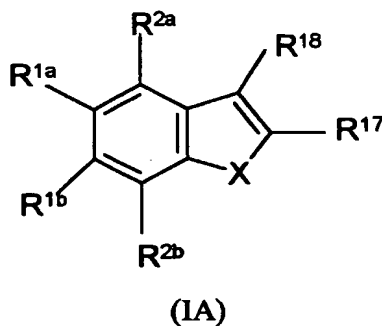


where x is 0 or 1, R^{10} is an C_{1-20} alkyl group, and y and z are independently selected from 0, 1 or 2.

5

6. A liquid crystal compound according to claim 1 which is of general formula (IA)

10



where X is oxygen, sulphur or selenium, R^{1a} and R^{1b} are independently selected from hydrogen, cyano, halo, optionally substituted hydrocarbyl, optionally substituted heterocyclyl or carboxy or a hydrocarbyl ester or amide thereof, provided that at least one group R^{1a} or R^{1b} is other than hydrogen; one of R^{17} or R^{18} is cyano, halo, optionally substituted hydrocarbyl, optionally substituted heterocyclyl or carboxy or a hydrocarbyl ester or amide thereof, and the other is hydrogen, halo, nitro, lower alkyl optionally substituted by halo, or a group $R^{15}C(O)O-$ where R^{15} is an optionally substituted hydrocarbyl group; R^{2a} and R^{2b} are independently selected from hydrogen, halo, nitro, lower alkyl optionally substituted by halo, or a group $R^{14}C(O)O-$ where R^{14} is as defined above;

20

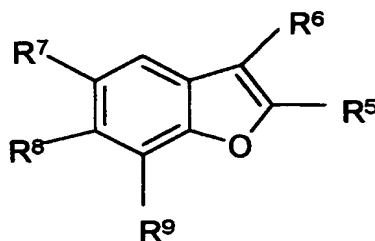
subject to the provisos that:

- (i) at least one group R^{1a} or R^{1b} or R^{17} or R^{18} is other than cyano or halo;
- (ii) where X is S, R^{17} is carboxy or a hydrocarbyl ester or amide thereof, R^{18} is hydrogen, R^{2a} and R^{2b} are not both fluoro;
- 5 (iii) where X is O, R^1 is an optionally substituted hydrocarbyl or carboxy or a hydrocarbyl ester or amide thereof, R^{2a} is hydrogen, and R^{1b} and R^{2b} are both fluorine, then R^{17} is other than C_{1-8} alkyl.

7. A compound according to claim 6 wherein one of R^{1b} or R^{1a} or R^{17} or R^{18} in
 10 formula (IA) is cyano or halo and at least one of the said groups on the other ring of the bicyclic ring of formula (IA) is optionally substituted alkyl, optionally substituted cycloalkyl, optionally substituted alkenyl, optionally substituted alkynyl, an optionally substituted aryl, optionally substituted heterocyclyl, carboxy or a hydrocarbyl ester thereof.

15

8. A compound according to claim 1 of formula (II)



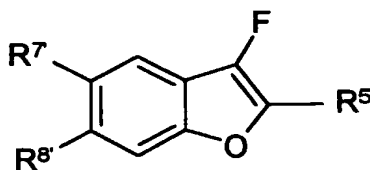
(II)

- 20 wherein R^5 is a group R^3 as defined above in claim 1, one of R^7 and R^8 is a group R^1 as defined in claim 1 and the other is hydrogen or a group R^1 as defined in claim 1;
 R^6 is hydrogen, cyano or fluoro,
 R^9 is hydrogen, cyano or fluoro,
 provided that where R^5 is cyano or fluoro, at least one of R^7 or R^8 is optionally
 25 substituted alkyl, optionally substituted cycloalkyl, optionally substituted alkenyl,
 optionally substituted alkynyl, optionally substituted alkoxy, optionally substituted aryl,
 optionally substituted heterocyclyl, carboxy or an ester thereof, and where one of R^7 or

R^8 is cyano or fluoro and the other is hydrogen, R^5 is optionally substituted alkyl, optionally substituted alkenyl, optionally substituted alkynyl, optionally substituted alkoxy, optionally substituted aryl, optionally substituted heterocyclyl, carboxy or an ester thereof.

5

9. A compound according to claim 8 of formula (IIA)



(IIA)

10 where $R^{5'}$ is cyano or fluoro, preferably fluoro, one of R^7 and R^8 is hydrogen and the other is an optionally substituted hydrocarbonyl group or a heterocyclic group as described above.

10. A compound according to claim 9 wherein at least one of R^7 or R^8 is a group of sub-formula (i), (ii), (iii), (vi) or (viii) as defined in claim 5.

15

11. A liquid crystal compound according to any one of claims 1 to 7 where X is oxygen.

20 12. A liquid crystal compound according to claim 8 which comprises a compound of formula (II) where R^6 is hydrogen or fluoro, and R^9 is hydrogen or fluoro.

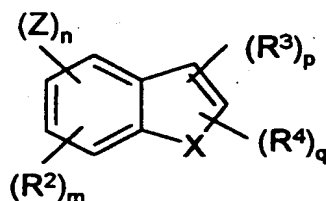
13. A liquid crystal mixture comprising a compound according to any one of the preceding claims.

25

14. A liquid crystal mixture according to claim 13 which comprises at least two different compounds according to any one of claims 1 to 12.

15. A liquid crystal device such as a liquid crystal display device (LCD) comprising a compound according to any one of claims 1 to 12 or a mixture according to claim 13 or claim 14.
- 5 16. A liquid crystal compound according to any one of claims 1 to 12 or a mixture according to claim 13 or claim 14, which has electroclinic properties.
17. An electroclinic device comprising a liquid crystal compound or a mixture according to claim 16.
- 10 18. A liquid crystal compound according to any one of claims 1 to 12 or a mixture according to claim 13 or claim 14, which has cholesteric properties.
- 15 19. A device comprising a liquid crystal compound or a mixture according to claim 18, wherein said device is a thermoptic, thermographic or electro-optical device.
- 20 20. A liquid crystal compound according to any one of claims 1 to 12 or a mixture according to claim 13 or claim 14, which has ferroelectric properties.
- 20 21. A ferroelectric device comprising a liquid crystal compound or a mixture according to claim 20.
22. A liquid crystal compound according to any one of claims 1 to 12 or a mixture according to claim 13 or claim 14, which has flexo-electric properties.
- 25 23. A flexo-electric device comprising a liquid crystal compound or a mixture according to claim 22.
24. A liquid crystal compound according to any one of claims 1 to 12 or a mixture according to claim 13 or claim 14, which has pyro-electric properties.
- 30 25. A pyro-electric device comprising a liquid crystal compound or a mixture according to claim 24.

26. A method of preparing a compound of formula (I) according to claim 1 which comprises either (i) reacting a compound of formula (III)



(III)

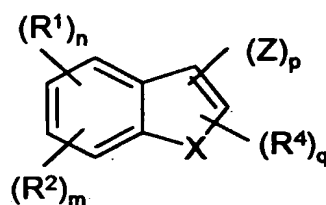
where R^2 , R^3 , R^4 , X , n , m , p and q are as defined in claim 1, and Z is either a leaving group or a group $B(OH)_2$, with a compound of formula (IV)



(IV)

where R^1 is as defined in relation to formula (I) and Z' is a group $B(OH)_2$ where Z is a leaving group, or a leaving group where Z is a group $B(OH)_2$; or

(ii) reacting a compound of formula (V)



(V)

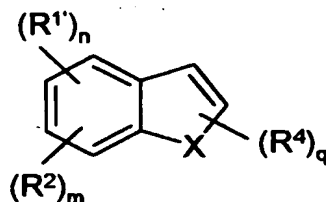
where R^1 , R^2 , R^4 , X , n , m , p and q are as defined in relation to formula (I), and Z is as defined in relation to formula (III), with a compound of formula (VI)



(VI)

where R^3 is as defined in relation to formula (I) and Z' is as defined in relation to formula (IV), or

(iii) where q is 0 and p is 1 and R^3 is a carboxy group, carboxylating a compound of formula (IX)

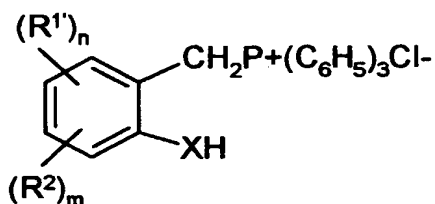


5

(IX)

where R^2 , R^4 , X , m , n and q are as defined in relation to formula (I), and $R^{1'}$ is a group R^1 as defined in relation to formula (I) or a precursor thereof, with a carboxylating agent, and thereafter acidifying the product with an acid such as glacial acetic acid, or

10 (IV) where q is 0, reacting a compound of formula (XIII)



(XIII)

where $R^{1'}$, R^2 , X , n and m are as defined above, with a compound of formula (XIV)

15



(XIV)

where $R^{3'}$ is a group R^3 as defined in relation to formula (I) or a precursor thereof, and thereafter, if necessary, changing any groups R^1 , R^2 , R^3 or R^4 to different such groups.

20